NN-EXPLORE

NASA-NSF Exoplanet Observational Research

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Jet Propulsion Laboratory
California Institute of Technology

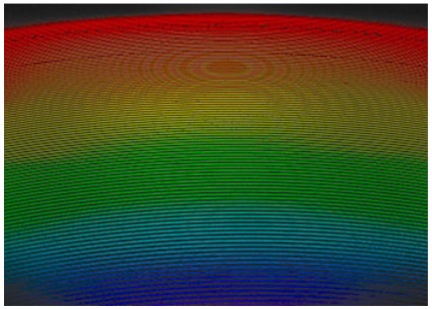
NN-EXPLORE

WIYN/NEID and Guest Observing (GO)

The NEID spectrograph is commissioned on the 3.5-meter WIYN telescope on Kitt Peak, Arizona with opportunities for guest observing on WIYN.

Southern RV Observing Opportunities

Radial velocity observing time in the southern hemisphere is available for US institutions on SMARTS/Chiron and MINERVA-Australis.



NASA-NSF EPRV Initiative

NASA and NSF are pursuing a new effort in Extreme-Precision Radial Velocity (EPRV).

More information: https://exoplanets.nasa.gov/exep/NNExplore/

NN-EXPLORE (NEID)

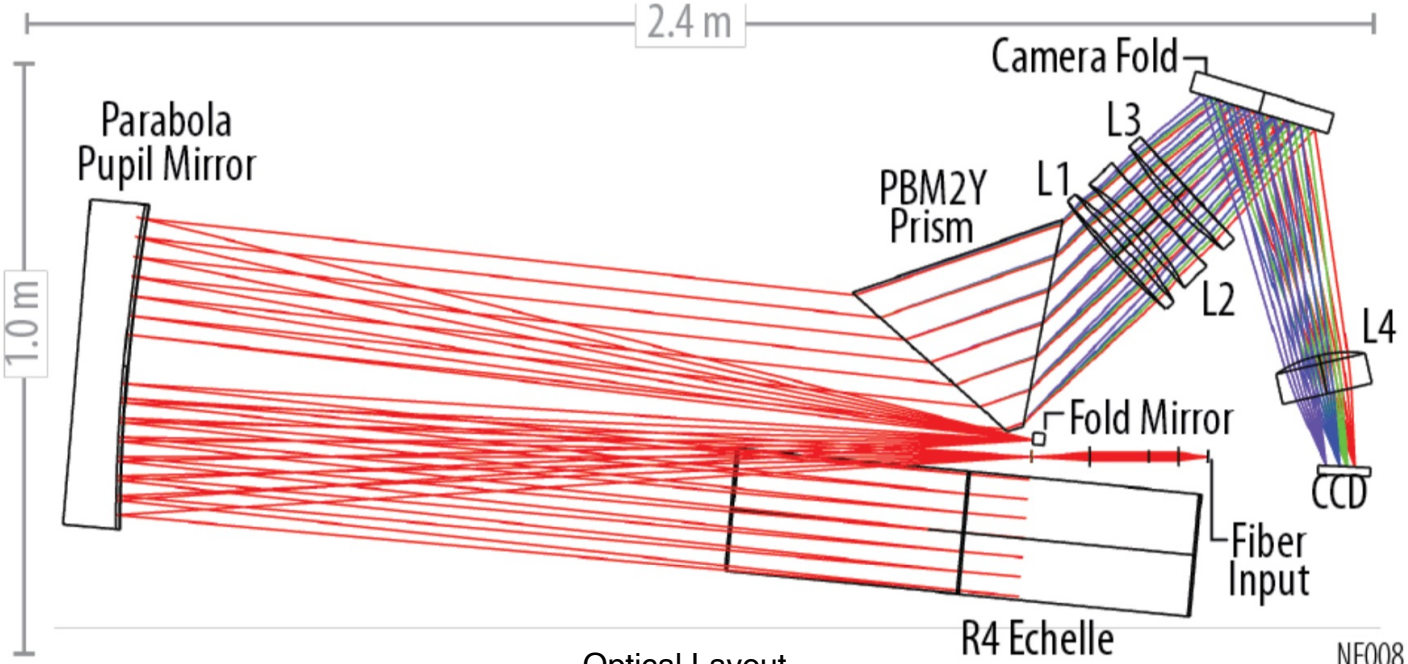
- NN-EXPLORE established with 2015 addendum (entitled "*Use of the WIYN Telescope for the NASA-NSF Partnership for Exoplanet Observational Research*") to the 2008 Memorandum of Agreement (MOA) on Space, Earth, and Biological Sciences Cooperative Activities between NSF and NASA.
  - NASA
    - Funded the development of the NEID spectrograph, telescope port adapter, and facility modifications.
    - Funds the instrument operations and maintenance, the GO and GTO observer programs, and the data processing and data archive.
  - NSF
    - Provides the 40%-time of WIYN (~120 nights/year) for NN-EXPLORE.
    - Funds telescope operations and maintenance.
    - Operates the time allocation committee (TAC) for all proposals.

NEID Spectrograph

NEID - **N**N-EXPLORE **E**xoplanet **I**nvestigations with **D**oppler Spectroscopy

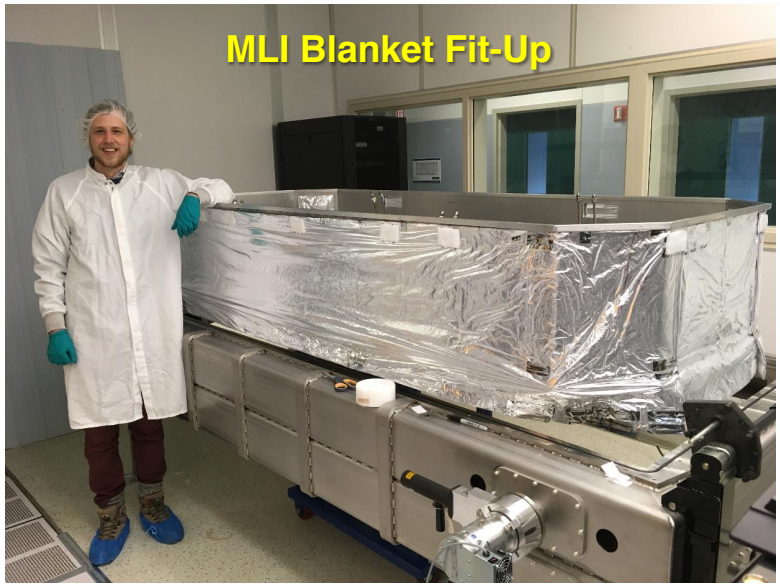
(O'odham for "to discover/visualize")

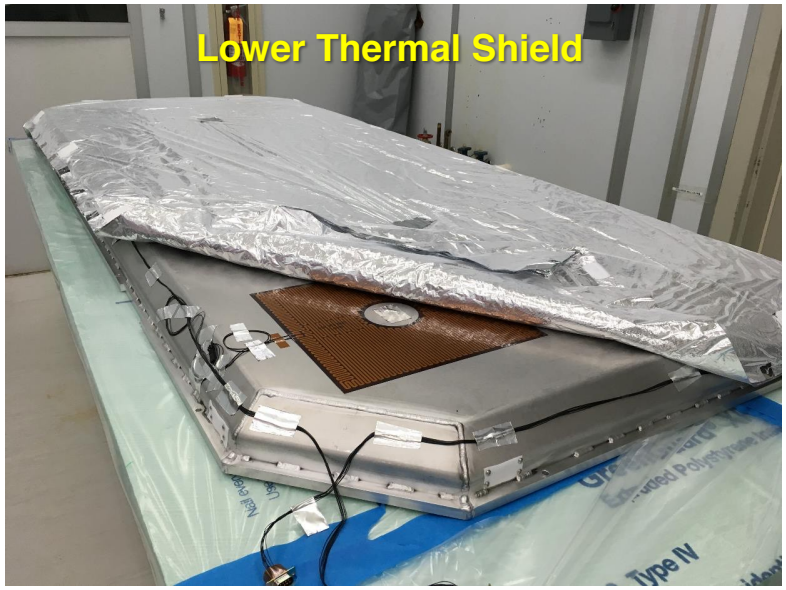
- Precision radial velocity of **~27 cm/s**
- **380 nm - 930 nm** bandwidth (RV coverage for F-M stars and stellar activity indicators)
- R = 100,000 spectral resolution of bright (V<12) stars
- e2v 9k x 9k CCD with 10 μm pixels
- **Environmental chamber with P < 10^{-7} torr and ΔT < ±1 mKelvin**
- **Laser Frequency Comb calibration**



Optical Layout

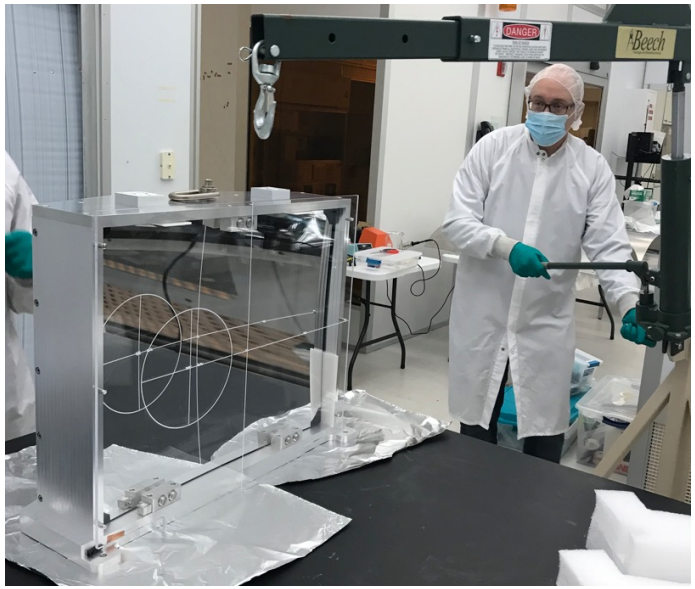
NEID Chamber

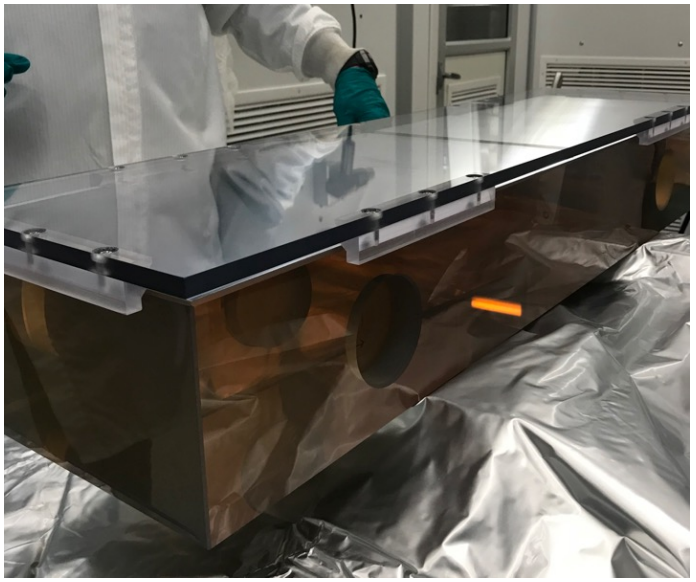




NEID Large Optics

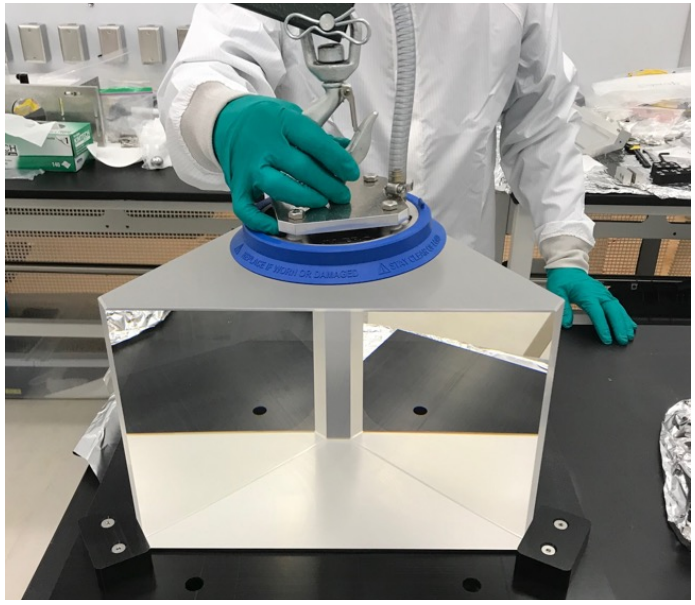
Off-Axis Paraboloid

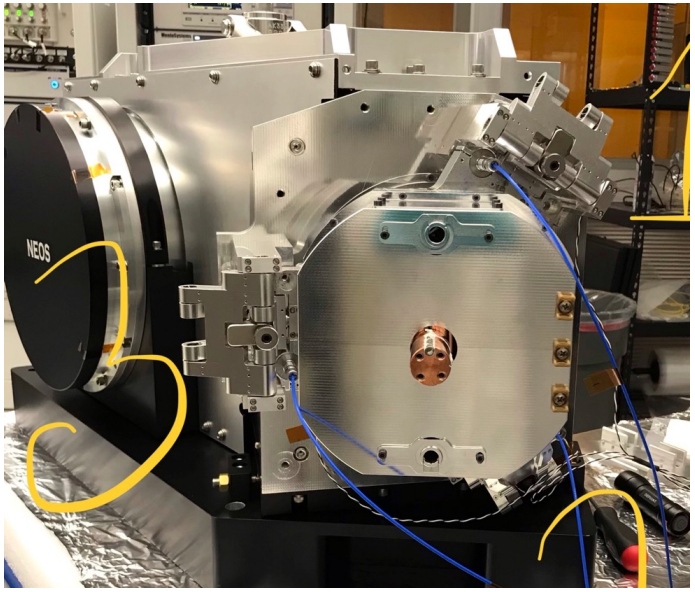




Echelle Grating

Prism

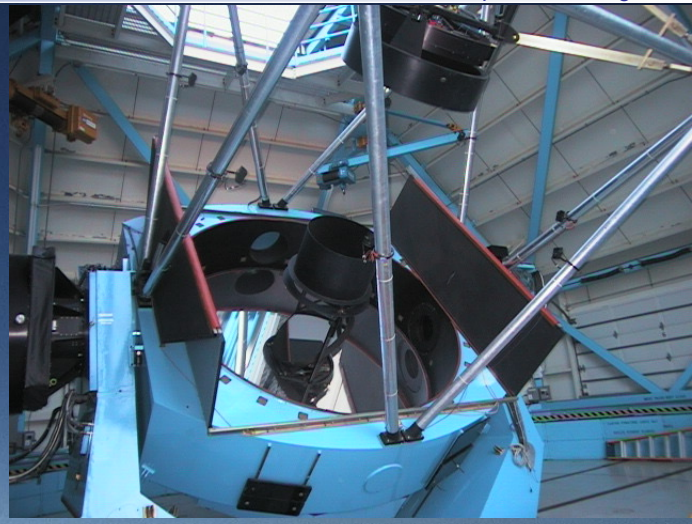




Camera

NEID Spectrograph

WIYN 3.5-m at Kitt Peak



noirlab.edu

Facility Refurbishment at WIYN

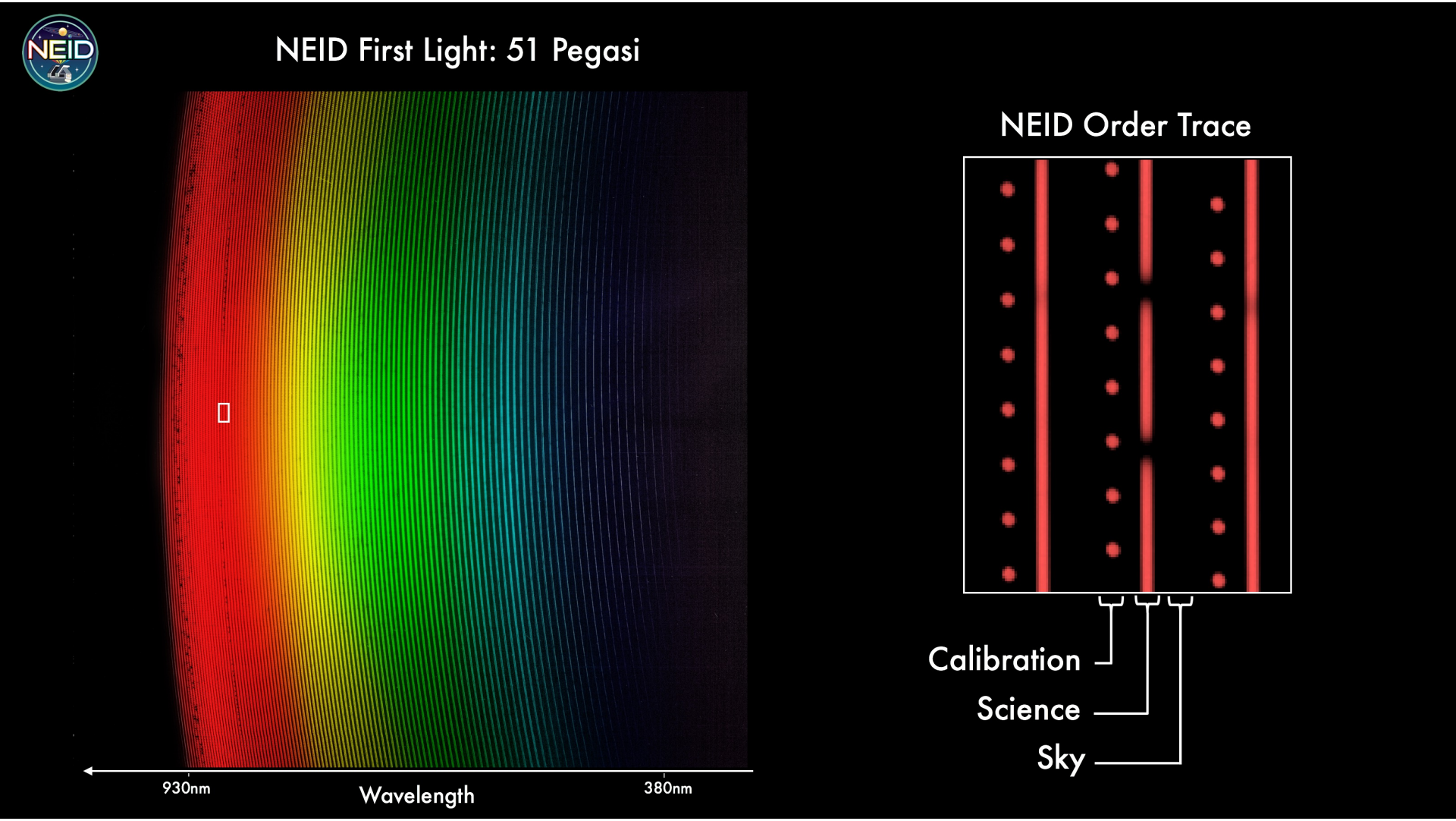
New cleanroom facilities for the spectrograph and calibration system

Extensive new HVAC system for stable environmental control

WIYN Telescope Port Adapter

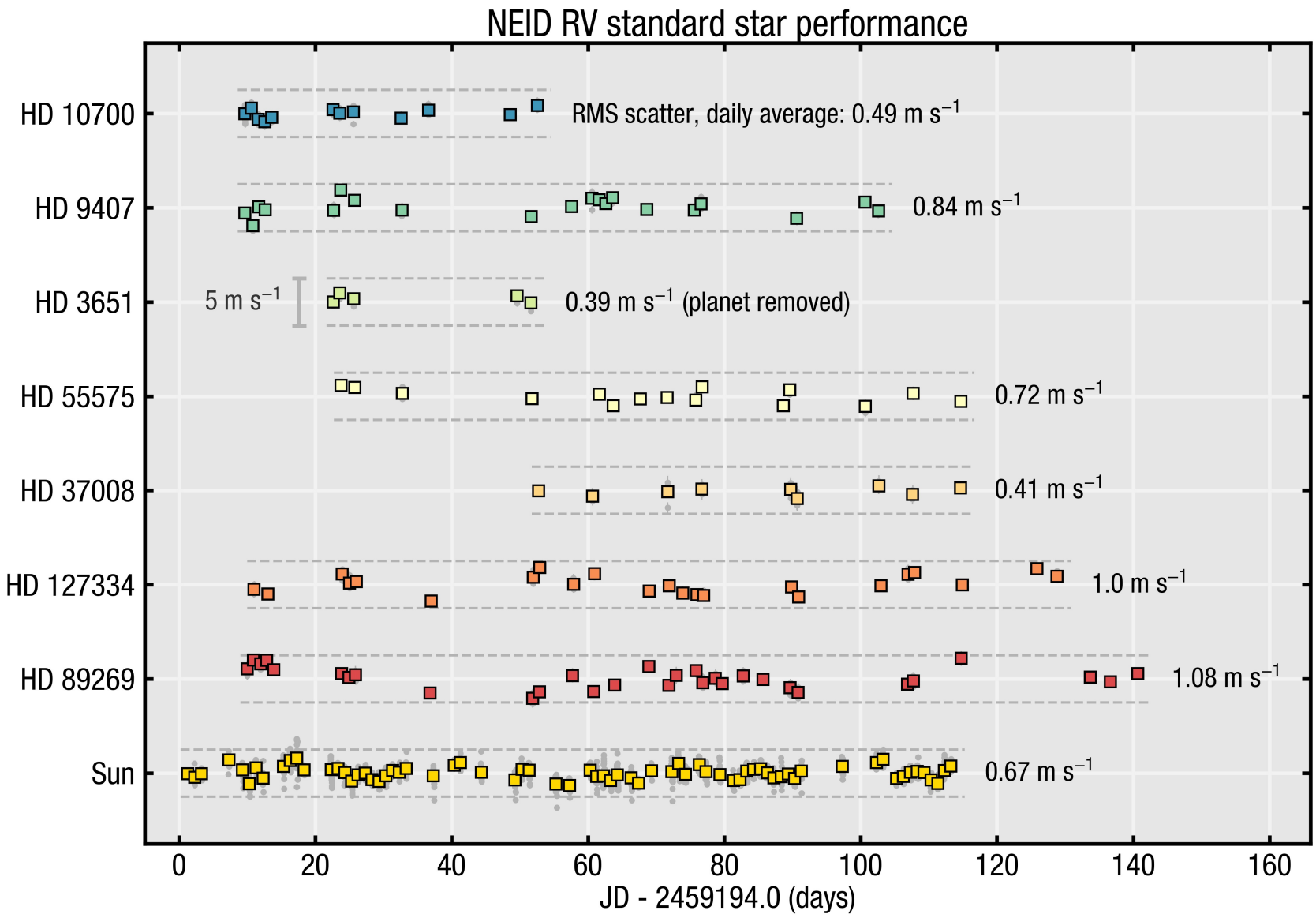
NEID Solar Telescope

NEID First Light



NEID Commissioning Performance

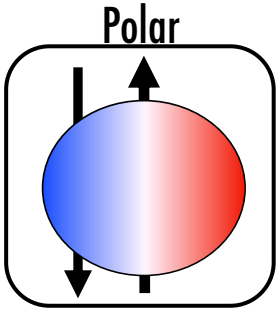
ExoPlanet Exploration Program

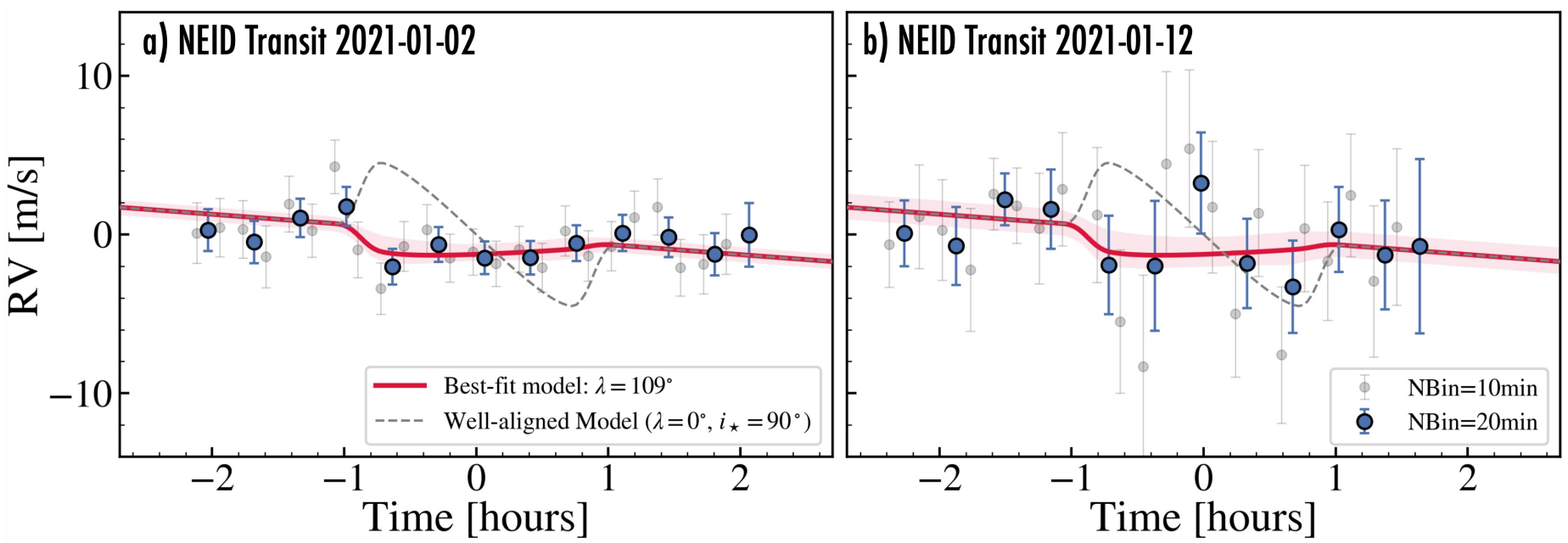


NEID Rossiter-McLaughlin Results

ExoPlanet Exploration Program

NEID reveals that the warm Neptune GJ 3470b—orbiting a nearby bright low mass star—has a polar orbit





The true obliquity constrained to be $\psi = 98^{+20^\circ}_{-10}$.

Stefánsson et al. 2021 (in prep)

Southern Radial Velocity

SMARTS/Chiron

AAT/Veloce

MINERVA-Australis

Facility	2019A	2019B	2020A	2020B	2021A	2021B	2022A	2022B	2023A
SMARTS/Chiron	392 hrs	407 hrs	80 hours	280 hrs	300 hrs	300 hrs	300 hrs	300 hrs	300 hrs
AAT/Veloce		5 nights	5 nights						
MINERVA-Australis				300 hrs	300 hrs	300 hrs	300 hrs	300 hrs	300 hrs

- NASA funds the observing time at each observatory.
- NSF operates the TAC for all proposals.
  - The NASA time on SMARTS/Chiron funded as an inter-agency transfer (IAT) through NSF.

Extreme-Precision Radial Velocity (EPRV)

- National Academies Exoplanet Science Strategy:

  "NASA and NSF should establish a strategic initiative in extremely precise radial velocities (EPRVs) to develop methods and facilities for measuring the masses of temperate terrestrial planets orbiting Sun-like stars."

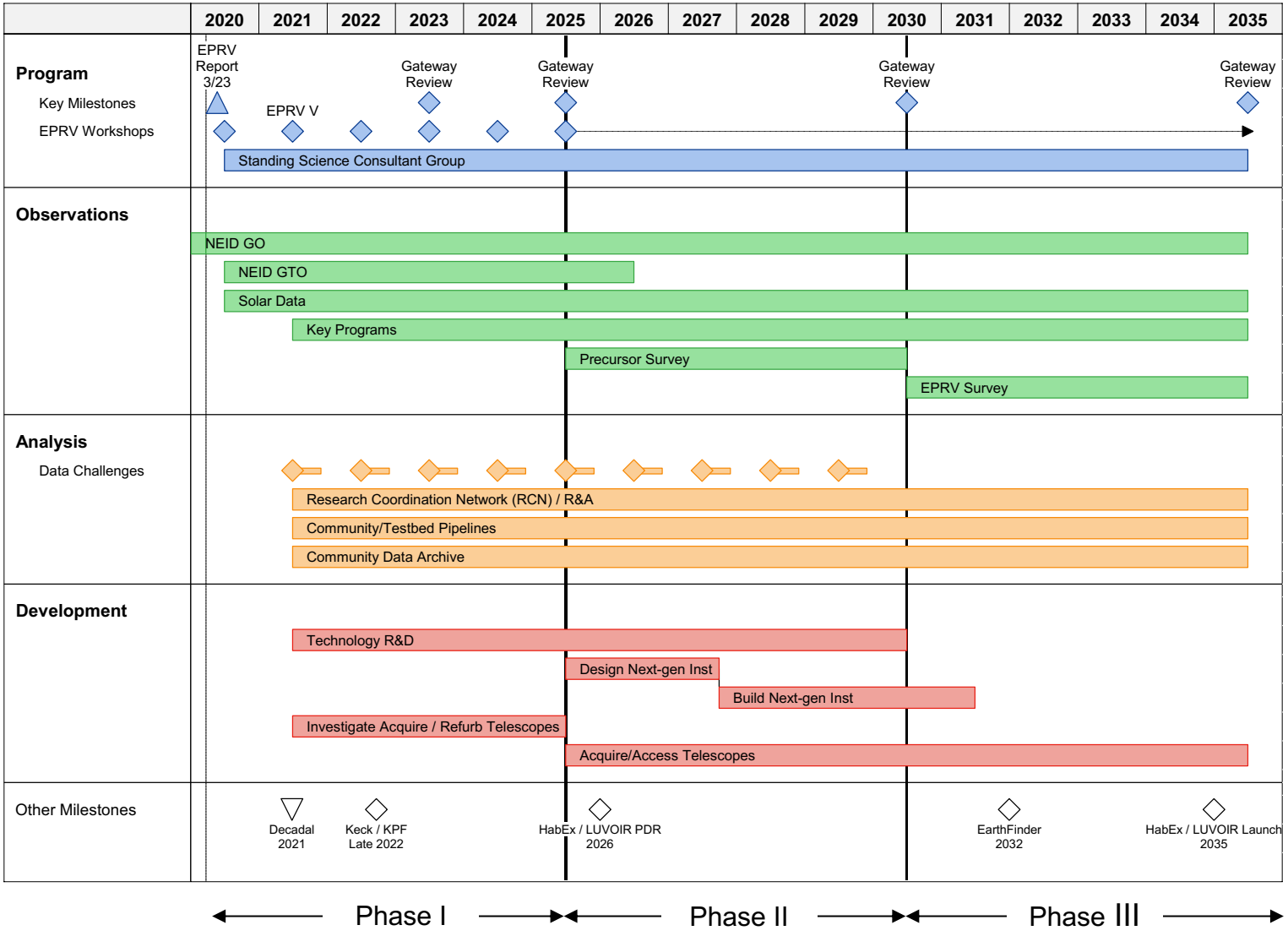
- Formed an EPRV working group of international experts.
  - Eight sub-groups (Science, Error Budget, Instrumentation, Stellar Variability, Strategies, Analytics, Resource Evaluation and Tellurics)
  - Three face-to-face workshops (St. Louis, New York, Washington)
  - Dozens of teleconferences
- Developed an EPRV roadmap recommended plan and presented it to NASA and NSF on 2020-03-24 and published the EPRV Working Group Final Report on 2021-08-04.

  See: https://exoplanets.nasa.gov/internal_resources/1556/ and https://exoplanets.nasa.gov/internal_resources/2000/

EPRV Notional Roadmap

ExoPlanet Exploration Program

3/23/2020



EPRV Early Steps

- PRV data in the NExScI community archive.
  - NEID solar data collected daily and publicly released through the NExScI community archive.
  - NEID standard stars publicly released.
- NSF funded 17 new awards in EPRV instrumentation and technology in FY20 and FY21.
- NASA funded eight 2-year EPRV Fundamental Science ROSES Solicitation D.17 awards.

  https://nspires.nasaprs.com/external/solicitations/summary!init.do?solId={8BEF2D63-6E33-C28A-B68B-8EF929B90D74}&path=open
- Updating the NASA/ApD Technology Gap List with EPRV
  - e.g., advanced photonics, visible AO/single-mode fiber, gratings, calibration standards, detectors, etc.
- Hiring an EPRV investigation scientist at JPL.
- Forming an EPRV Research Coordination Network (RCN)
  - To be initiated with the first EPRV solicitation PIs.
  - Interagency, interdivisional, interdisciplinary, international, intergenerational
- Waiting on the Decadal recommendations with a spectrum of options ready to respond.

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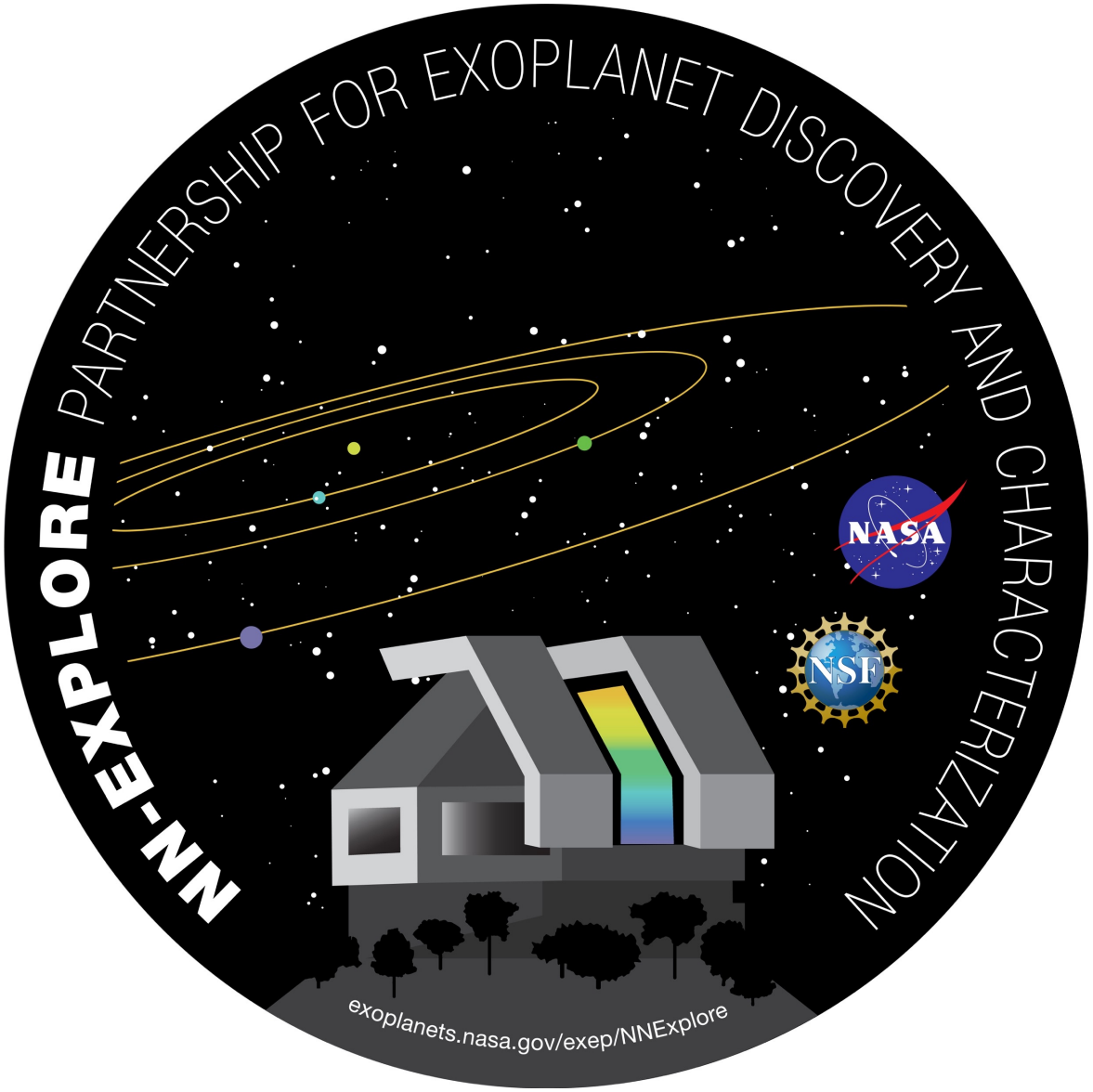
NN-EXPLORE PARTNERSHIP FOR EXOPLANET DISCOVERY AND CHARACTERIZATION
NASA
NSF
exoplanets.nasa.gov/exep/NNExplore